

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2022550PC/ko	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/FI2003/000824	International filing date (day/month/year) 05.11.2003	Priority date (day/month/year) 05.11.2002
International Patent Classification (IPC) or national classification and IPC E21B 44/00		
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1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of 6 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

<input checked="" type="checkbox"/>	Box No. I	Basis of the report
<input type="checkbox"/>	Box No. II	Priority
<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
<input type="checkbox"/>	Box No. IV	Lack of unity of invention
<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
<input type="checkbox"/>	Box No. VI	Certain documents cited
<input type="checkbox"/>	Box No. VII	Certain defects in the international application
<input type="checkbox"/>	Box No. VIII	Certain observations on the international application

Date of submission of the demand 26.04.2004	Date of completion of this report 25.01.2005
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Christer Bäcknert / MRO Telephone No. +46 8 782 25 00

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-16</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-16</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-16</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:

D1: EP 0112810 A2

D2: EP 0080446 A2

D3: US 4195699 A

The cited documents represent the general state of the art.
The invention defined in claims 1-16 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed method for controlling rock drilling and rock drilling arrangement. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1-16 is novel and is considered to involve an inventive step.

The invention is industrially applicable.

Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of:

- ☐ international search (under Rules 12.3 and 23.1(b))
☐ publication of the international application (under Rule 12.4)
☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

☐ the international application as originally filed/furnished

☒ the description:

pages 1 - 15 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 16 - 21 received by this Authority on 12.10.2004

pages* _____ received by this Authority on _____

☐ the drawings:

pages 1 - 9 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing (*specify*): _____
☐ any table(s) related to the sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, sheets/figs _____
☐ the sequence listing (*specify*): _____
☐ any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

CLAIMS (amended on October 12, 2004)

1. A method for controlling rock drilling

wherein a percussion device (7, 25) belonging to a rock drill machine (1) delivers impact pulses to rock (10) through a tool (12) and wherein the rock drill machine (1) is simultaneously pushed against the rock (10) by means of a feed actuator (3, 33),

the method comprising :

feeding a pressure medium to the feed actuator (3, 33) along at least one feed channel (37, 38, 4, 5);

feeding the pressure medium to the percussion device (7, 25) along at least one percussion pressure channel (24, 13, 14);

determining a penetration rate; and

adjusting at least a percussion pressure on the basis of the penetration rate,

characterized by

conveying at least one pressure medium flow supplied to or from the feed actuator (3, 33) through at least one restrictor (46),

sensing the pressure of the pressure medium before the restrictor (46) and after the restrictor (46) in order to determine the penetration rate, and

adjusting the percussion pressure on the basis of the monitoring.

2. A method as claimed in claim 1, **characterized by**

interpreting that the penetration rate has increased when, due to pressure drops, the pressure after the restrictor (46) is decreased relative to a reference pressure before the restrictor (46), and

decreasing the percussion pressure when the penetration rate increases.

3. A method as claimed in claim 1 or 2, **characterized by** adjusting the percussion pressure in a predetermined manner with respect to the change of the penetration rate.

4. A method as claimed in any one of the preceding claims, **characterized by** decreasing the percussion pressure and the feed pressure in a substantially constant ratio when the penetration rate increases.

5. A method as claimed in any one of the preceding claims, **characterized by**

measuring, by pressure sensors (50, 51), the magnitude of the pressure active before the restrictor (46) and the pressure after the restrictor, delivering pressure data to a control unit (52),

determining, at the control unit, the penetration rate on the basis of
5 the pressure data,

adjusting, by means of the control unit (52), at least one electrically controlled valve (31) in order to decrease the percussion pressure when the penetration rate increases.

6. A rock drilling arrangement comprising:

10 a rock drill machine (1) including a percussion device (7, 25) arranged to generate impact pulses to a tool (12) to be connected to the rock drill machine (1);

a feed beam (2) whereon the rock drill machine (1) has been arranged;

15 a feed actuator (3, 33) enabling the rock drill machine (1) to be moved in the longitudinal direction of the feed beam (2);

a pressure medium system comprising: at least one pressure source; at least one pressure medium channel (13, 14, 24) leading to the percussion device (7, 25); at least one feed channel (4, 5, 37, 38) connected to
20 the feed actuator (3, 33); and means for adjusting a percussion pressure, **characterized** in that

at least one restrictor (46) is connected to at least one feed channel (37) of the feed actuator,

25 the arrangement comprises means for sensing the pressure active in the feed channel before the restrictor (46) and after the restrictor (46), and

the pressure medium arrangement is arranged to decrease the percussion pressure when the pressure in the feed channel after the restrictor (46) is smaller than the pressure before the restrictor (46).

7. A rock drilling arrangement as claimed in claim 6, **characterized** in that
30

a first sensing channel (47) is connected to a section (37) of the feed channel residing before the restrictor (46) in the direction of flow and a second sensing channel (48) is connected to a section (37') after the restrictor,

35 the first sensing channel (47) is connected to a first pressure sensor (50) and the second sensing channel (48) is connected to a second pressure sensor (51),

the arrangement includes at least one control unit (52),
 pressure data obtained from the first pressure sensor (50) and pressure data obtained from the second pressure sensor (51) are arranged to be conveyed to the control unit (52),

5 the control unit (52) is arranged to monitor a penetration rate on the basis of the pressure data obtained from the pressure sensors,

the control unit (52) is provided with a control strategy for adjusting the percussion pressure in a predetermined manner with respect to the penetration rate, and

10 the arrangement includes at least one valve (31) controlled by the control unit (52) for adjusting the percussion pressure.

8. A rock drilling arrangement as claimed in claim 7, **characterized** in that

the control unit (52) is provided with a control strategy for adjusting
 15 a feed pressure in a predetermined manner with respect to the penetration rate, and

the arrangement includes at least one valve (44) controlled by the control unit (52) for adjusting the feed pressure.

9. A rock drilling arrangement as claimed in claim 6, **characterized** in that

20 the arrangement comprises at least one monitoring valve (56, 71) for adjusting the percussion pressure,

the monitoring valve (56, 71) comprising:

a body (90),

25 an elongated slide (91) having a first end and a second end and arranged to a space in the body (90) and movable in the longitudinal direction in said space,

at least one force element that is arranged to act on the first end of the slide (91) to move the slide (91) towards a first direction of travel (B), and

30 at least one controllable channel (108) that is arranged to open and close by the longitudinal movement of the slide (91),

the slide (91) has at least one collar (95),

a sleeve (96) is arranged around the slide (91),

the body (90) has a space, inside which the collar (95) and the
 35 sleeve (96) are arranged to move,

the outer rim of the sleeve (96) is sealed to the body (90) and the inner rim of the sleeve is sealed to the slide (91),

the sleeve (96) defines a first chamber (97) and a second chamber (98) on opposite sides of the sleeve (96), and said chambers (97, 98) are not
5 connected to each other,

the first chamber (97) is connected at least to a first pressure channel,

the second chamber (98) is connected at least to a second pressure channel,

10 the sleeve (96) is arranged to move in the first (B) or the second (A) direction of travel depending on the pressure difference inside the chambers (97, 98), and

in one direction of travel, the sleeve (96) is arranged to act on the axial position of the slide (91) when abutting on the collar (95).

15 10. A rock drilling arrangement as claimed in claim 9,

characterized in that in the monitoring valve (56)

the sleeve (96) is arranged to abut on the collar (95), on the same side as the force element,

the first chamber (97) is on the force element side of the sleeve (96)
20 and the second chamber (98) is on the collar (95) side of the sleeve,

the first chamber (97) is connected to a sensing channel (99),

the second chamber (98) is connected to a reference channel (100),

the sleeve (96) is arranged to push via the collar (95) the slide (91) towards the first direction of travel (B), if the pressure of the sensing channel
25 (99) is higher than that of the reference channel (100).

11. A rock drilling arrangement as claimed in claim 9,

characterized in that in the monitoring valve (71)

the sleeve (96) is arranged to abut on the collar (95), on the opposite side of the collar (95) with respect to the force element,

30 the first chamber (97) is on the force element side of the sleeve (96) and the second chamber (98) is on the opposite side of the sleeve (96),

the first chamber (97) is connected to a reference channel (100),

the second chamber (98) is connected to a sensing channel (99),

the sleeve (96) is arranged to push via the collar (95) the slide (91) towards the second direction of travel (A), if the pressure of the sensing channel
35 (99) is higher than that of the reference channel (100).

11, 12. A rock drilling arrangement as claimed in any one of claims 9 to

characterized in that in the monitoring valve (71)

the force element is a spring (59) and the pushing force of the
5 spring (59) is adjustable.

12, 13. A rock drilling arrangement as claimed in any one of claims 9 to

characterized in that in the monitoring valve (56, 71)

10 the second end of the slide (91) is arranged tightly to a bore (93) in
the body (90),

the pressure of the controllable channel (108) is arranged to act on
the end surface of the second end of the slide (91),

the bore (93) is connected to at least one transverse discharge
channel (110), and

15 the second end of the slide (91) is arranged to open and close the
connection between the controllable channel (108) and discharge channel
(110).

14. A rock drilling arrangement comprising:

20 a rock drill machine (1) including a percussion device (7, 25) ar-
ranged to generate impact pulses to a tool (12) to be connected to the rock drill
machine (1);

a feed beam (2) whereon the rock drill machine (1) has been ar-
ranged;

25 a feed actuator (3, 33) enabling the rock drill machine (1) to be
moved in the longitudinal direction of the feed beam (2);

a pressure medium system comprising: at least one pressure
source; at least one pressure medium channel (13, 14, 24) leading to the per-
cussion device (7, 25); at least one feed channel (4, 5, 37, 38) connected to
the feed actuator (3, 33); and means for adjusting a percussion pressure,

30 **characterized** in that

the arrangement comprises at least one adjustment unit (34) for
controlling the feed actuator (33),

at least two relief valves (63, 64) arranged in series in load-sense
channel (43) of the adjustment unit (34),

35 at least one restrictor (46) connected to the inlet feeding channel of
the feed actuator (33),

the arrangement comprises means for controlling the pressure difference between the inlet feeding channel of the feed actuator (33) and a reference pressure sensed in-between the mentioned two relief valves (63, 64) in the load-sense circuit of the adjustment unit (34) of the feed actuator (33),

5 the reference pressure in-between the two relief-valves (63, 64) is sensed,

 the pressure after the restrictor (46) is sensed, and

 the arrangement comprises a control system which is arranged to decrease the percussion pressure when the pressure difference between the
10 above-mentioned sensed pressures decreases.

15. A rock drilling arrangement as claimed in claim 14, **characterized** in that the restrictor (46) is adjustable.

16. A rock drilling arrangement as claimed in claim 14, **characterized** in that the restrictor (46) has fixed settings.
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